

CLAIMS

1. A method for locally repairing a damaged thermal barrier coating on a component surface, the method comprising the steps of:

providing a ceramic coating composition comprising ceramic powders provided in two predetermined particle size ranges of less than 1 micron but greater than 30 nanometers and between about 45 microns to about 75 microns, respectively, fumed ceramic material with a particle size of no greater than 30 nanometers, and a binder suspended in a solvent, the binder being chosen from the group consisting of ceramic precursor binders that thermally decompose to form a refractory material;

spraying the ceramic coating composition on a surface area of the component exposed by the localized damage to form an uncured coating, the uncured coating composition characterized by the ability to flow when subjected to a mechanical stress and to remain in place when the mechanical stress is removed; and

curing the coating composition for a period sufficient to yield a dried coating that covers the surface area of the component, the dried coating comprising the ceramic powders and fumed ceramic material in a matrix with the binder.

2. The method of claim 1, further including the steps of, prior to spraying the ceramic coating composition, cleaning the damaged area of the coating, and applying a bond coat.

3. The method of claim 1, wherein the fumed ceramic material has an average particle size of between 10 nanometers and 25 nanometers

4. A method according to claim 1, wherein the ceramic powders further comprise at least one ceramic material chosen from the group consisting of alumina, zirconia, hafnia, magnesia, titanium, calcium, and silica.

5. A method according to claim 4, wherein the fumed ceramic material is selected from the group consisting of alumina, titania, and silica.

6. A method according to claim 5, wherein the binder is selected from the group consisting of silicone binders and phosphate binders.

7. A method according to claim 1, wherein the component is a component of a gas turbine engine assembly.

8. A method according to claim 1, wherein the step of spraying is preceded by the step of

force brushing onto the surface area of the component exposed by local spallation a composition having between about 50 to about 70 percent by weight of a solvent, the balance of the composition comprising a mixture of ceramic powders provided in at least two predetermined particle size ranges, fumed ceramic material having an average particle size of between 10 nanometers and 25 nanometers, and a binder suspended in a solvent, the ceramic powders, the binder being chosen from the group consisting of ceramic precursor binders that thermally decompose to form a refractory material.

9. A method according to claim 1, wherein the step of spraying is performed in a non-controlled atmosphere using spray delivery systems selected from the group consisting of aerosol assisted canisters, pressurized air spray equipment, HVLP spray guns, and airless sprayers.

10. A method according to claim 1, further including the step of cleaning the surface area of the component prior to the step of force brushing so as to remove contaminants without removing any adherent residual fragments of the thermal barrier coating.

11. A method according to claim 1, further including the step of applying heat to the dried coating to decompose the binder to form a repair coating, the repair coating comprised of the ceramic powder and fumed ceramic material in a matrix of refractory material formed by thermal decomposition of the binder.

12. A method according to claim 11, wherein the step of applying heat to the dried coating is accomplished using a heat source selected from the group consisting of heat guns, heat blankets, heat lamps, and torches.

13. A method according to claim 11, wherein the step of applying heat to the dried coating is accomplished by installing the component in the flowpath of a gas turbine engine and operating the engine, during which the binder further decomposes to yield a repair coating comprised of a matrix containing ceramic material.

14. A method according to claim 1, wherein all repair steps are performed while the component remains installed in the flowpath of a gas turbine engine.

15. A method according to claim 1, wherein the ceramic powders comprise about 0.5 to about 45 weight percent of ceramic powder of at least 99% purity having a particle size less than about 1 micron but greater than about 30 nanometers; about 5 to about 75 weight percent of ceramic powder of at least 99% purity having a particle size between about 45 microns to about 75 microns; the fumed ceramic material comprising about 0.5 to about 10 weight percent of the composition, binder comprising about 5 to about 45 weight percent of the composition, and about 5 to about 70 weight percent solvent.

16. A method according to claim 1, wherein the ceramic powders comprise about 15 to about 25 weight percent of alumina of at least 99% purity and having a particle size less than 1 micron but greater than 30 nanometers, about 12 to about 22 weight percent of alumina at least 99% purity and having a particle size of between about 45 microns to about 75 microns, about 1 to about 9 weight percent fumed alumina, about 22 to about 33 weight percent of binder, and about 23 to about 33 weight percent solvent.

17. A method according to claim 1, wherein the damaged thermal barrier coating is yttria-stabilized zirconia deposited on a metallic bond coat.

18. A gas engine turbine component including a repaired region repaired by the method of claim 1.

19. A method for repairing a region of localized spallation in thermal barrier coating on a component installed in a gas turbine engine so as to expose a surface area of the region of localized spallation defined at least in part by a bond coat, the method comprising the steps of:

without removing the component from the gas turbine engine, dressing the surface area of the region of localized spallation so as to remove a predetermined region of thermal barrier coating down to the bond coat without damaging the bond coat;

applying a composition to the surface area of the component exposed by the local spallation, the composition comprising a ceramic composition comprising a mixture of ceramic powders, a ceramic precursor binder, and a fumed ceramic material suspended in a solvent of the composition, the ceramic powders provided in at least two predetermined

particle size ranges and comprising at least one of alumina, zirconia, hafnia, magnesia and silica, the binder being selected from the group consisting of silicone and phosphate-based compositions, the fumed material having a particle size of between 10 nanometers and 25 nanometers; and

evaporating the solvent to yield a ceramic-containing dried coating that covers the surface area of the component.

20. A method according to claim 19, wherein the fumed ceramic material is selected from the group consisting of alumina, titania, and silica.

21. The method of claim 20, further comprising the step of applying sufficient heat to the dried coating to decompose the binder to form a repair coating, the repair coating comprising the ceramic powders and fumed ceramic material in a matrix of material formed by thermal decomposition of the ceramic precursor binder.

22. A method according to claim 20, wherein the composition comprises about 0.5 to about 45 weight percent of ceramic powder of at least 99% purity having a particle size less than about 1 micron but greater than about 30 nanometers; and about 5 to about 75 weight percent of ceramic powder of at least 99% purity having a particle size between about 45 microns to about 75 microns; and wherein the balance of the composition comprises fumed ceramic material comprising about 0.5 to about 10 weight percent of the composition, binder comprising about 5 to about 45 weight percent of the composition, and about 23 to about 33 weight percent solvent.

23. A method according to claim 19, wherein the step of applying is performed in ambient conditions.

24. A repaired gas engine turbine component having a repair coating formed by the method of claim 18.

25. An air sprayable liquid coating composition comprising the combination of:
a first ceramic powder comprising alumina of at least 99% purity and having a particle size less than 1 micron but greater than 30 nanometers;
a second ceramic powder comprising alumina of at least 99% purity and having a particle size of between about 45 microns to about 75 microns;

a nano-sized ceramic material having an average particle size of between about 10 to about 25 nanometers;

a binder containing a ceramic precursor that will form a ceramic material upon thermal decomposition; and

sufficient amount of evaporable solvent to permit the composition to be sufficiently fluid to be air sprayed.

26. The composition of claim 25, wherein:

the first ceramic powder is about 0.5 to about 45 weight percent;

the second ceramic powder is about 5 to about 75 weight percent;

the nano-sized ceramic material is about 0.5 to about 10 weight percent;

the binder is about 5 to about 45 weight percent.

27. The composition of claim 26, wherein the first ceramic powder and the second ceramic powder are selected from the group comprising at least one ceramic material chosen from the group consisting of alumina, zirconia, hafnia, magnesia, titanium, calcium, and silica, and wherein the fumed ceramic material is selected from the group consisting of alumina, titania, and silica.

28. The composition of claim 27, wherein the binder is selected from the group consisting of silicone binders and phosphate binders.